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PAGES News
PAST GLOBAL CHANGES

Isabelle Larocque and Keith Alverson, Editors

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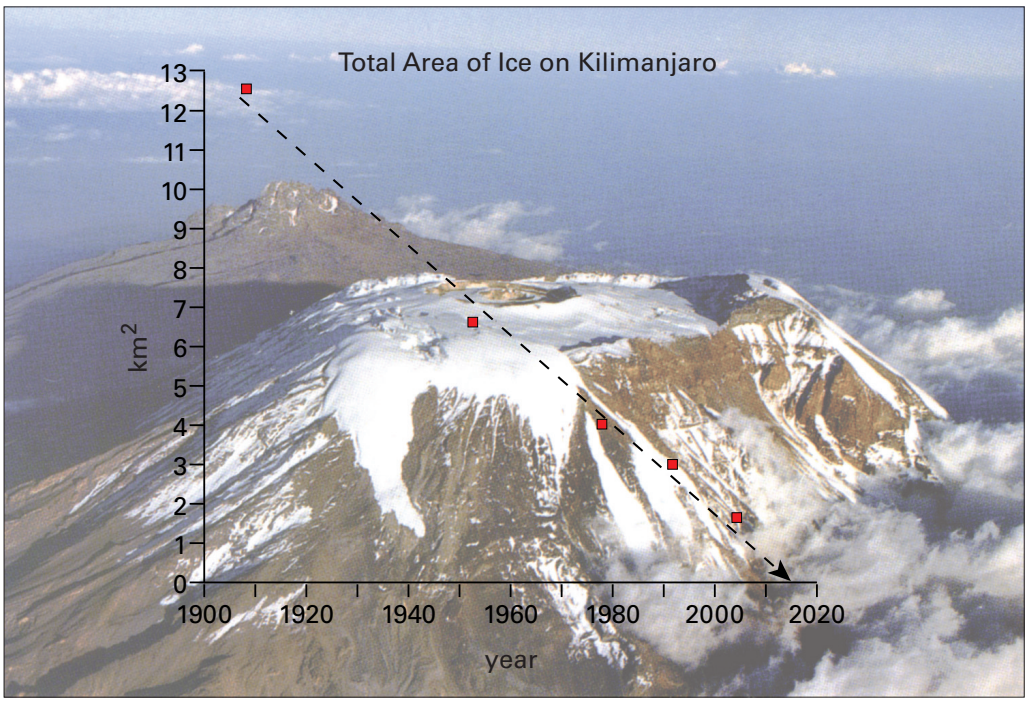
PEP II Special Issue



The extent of ice cover on Mt. Kilimanjaro decreased by 81% between 1912 and 2000. Disappearing paleoclimate archives such as this are a priority target of the Global Paleoclimate Observing System currently being proposed by PAGES scientists. For more information see the editorial in this issue of PAGES News. Photo: Captain G. Mazula, Data: Lonnie Thompson.

Contents

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Editorial
The Need for a Global Paleoclimate Observing System

A major obstacle standing in the way of producing reliable predictions of climate change and its impacts is a lack of data on timescales longer than the short instrumental record. Recently initiated climate observation programs will need to be continuously operated for at least 50 years before they begin to provide information that is relevant to this problem. Natural archives of past climate variability can provide relevant information now. Unfortunately, some of the most valuable paleoclimate archives are being rapidly destroyed, largely due to human influences. PAGES therefore calls on scientists, funding agencies and institutional partners to establish immediately a coordinated international Global Paleoclimate Observing System (GPOS) to complement and participate in the recently established Global Climate, Terrestrial and Ocean Observing Systems (GCOS, GTOS, GOOS) that focus only on contemporary observations (Alverson et. al (2001); Koenig (2001)).

A primary example of the loss of paleoarchives is the ongoing rapid retreat of alpine glaciers in both the tropics and temperate latitudes. Ice cores from such glaciers have been used to reconstruct temperature, precipitation and atmospheric dust levels and to provide records of changes in the strength of the Asian monsoon and ENSO. As shown in the figure on the cover of this issue the total area of the summit glacier on Kilimanjaro decreased by 82% between 1912 and 2000. Soon, the only information left from the Kilimanjaro ice will be what is left of the cores extracted last year by Lonnie Thompson and his group and stored in freezers at Ohio State University. The situation on Kilimanjaro is not an isolated one. Tropical warming is causing the rapid retreat of ice caps and glaciers at high elevations in the tropics and subtropics around the world. An extensive overview of the status of glaciers around the world is available on the world glacier monitoring service web site *(http://www.geo.unizh.ch/wgms/)*.

PAGES exists to facilitate interdisciplinary collaboration, provide publicly available paleoenvironmental data archives, and coordinate the efforts of the maze of publicly supported databases. PAGES will continue to work with the research community, and representatives of major paleoenvironmental database efforts, to ensure long term, open archiving of paleoclimate data. The collection of data already at the PAGES supported World Data Center for Paleoclimatology *(http://www.ngdc.noaa.gov/paleo/)* is enormously valuable. Get your site on the map!

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Quaternary Environmental Change in the Indonesian Region

Rien A.C. Dam[1], Sander van der Kaars[2] and A. Peter Kershaw[3]

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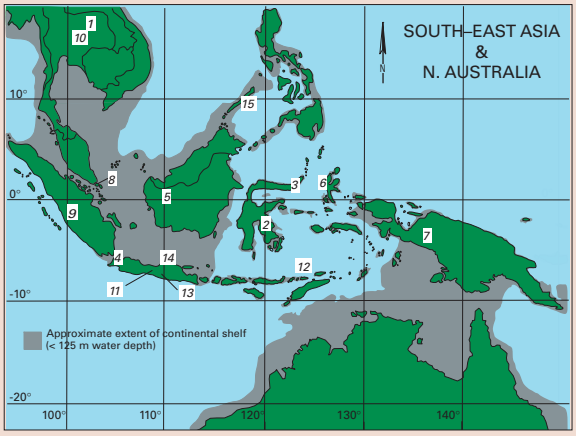
Numbers on the map refer to the contents of the special issue of Palaeo3, Volume 171 : Introduction: Quartenary environmental change in the Indonesian region ***1:*** *A 40,000 year palynological record from north-east Thailand; implications for biogeography and palaeoenvironmental reconstruction* ***2:*** *Environmental change in the Late Pleistocene and later Holocene at Wanda Site, Soroako, South Sulawesi, Indonesia* ***3:*** *Palaeoenvironmental developments in the Lake Tondano area (N. Sulawesi, Indonesia) since 33,000 years B.P.* ***4:*** *Palaeoecology, palynology and palaeolimnology of a tropical lowland swamp: Rawa Danau, West-Java, Indonesia* ***5:*** *A Late Pleistocene and Holocene pollen and charcoal record from peat swamp forest, Lake Sentarum Wildlife Reserve, West Kalimantan, Indonesia* ***6:*** *Late Quaternary tropical lowland environments on Halmahera, Indonesia* ***7:*** *Biomass Burning in Indonesia and Papua New Guinea: natural and human induced fire events in the fossil record* ***8:*** *Late Quaternary peat formation and vegetation dynamics in a lowland tropical swamp; Nee Soon, Singapore* ***9:*** *Evidence for continued disturbance of upland rain forest in Sumatra for the last 7,000 years of an 11,000 year record* ***10:*** *The geoarchaeology of the prehistoric ditched sites of the upper Mae Nam Mun valley, N.E. Thailand, III: Late Holocene vegetation history* ***11:*** *Pollen-stratigraphic evidence of human activity at Dieng, Central Java* ***12:*** *Pollen distribution in marine sediments from the south-eastern Indonesian waters* ***13:*** *The evolutionary history of humans in Australasia from an environmental perspective* ***14:*** *The Late Quaternary palaeogeography of mammal evolution in the Indonesian Archipelago* ***15:*** *Late Quaternary Terrestrial Vertebrates From Palawan Island, Philippines.*

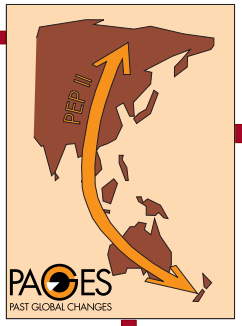


To highlight results of recent studies in the vital, but poorly understood equatorial region, a special volume (No. 171, July 2001) of the journal *Palaeogeography, Palaeoclimatology, Palaeoecology* is dedicated to Quaternary environmental change in the Indonesian region. A total of 15 research papers contain a wealth of palaeoenvironmental and palaeoecological information relevant for the attempts to integrate palaeoclimate data within the PEP II transect.

Austral–Asian Pole–Equator–Pole Transect PEP II Synthesis Meeting

National University Singapore, November 26–29th, 2001

Objective and Main Themes



To compile a synthesis of the past record of environmental change across the last two glacial cycles, the last two thousand years and during the historical period.

- Environment-Human Interactions
- History of monsoon circulation and ENSO
- Patterns of change in the Westerlies
- Evolution of drylands
- Sea level change, thermohaline circulation and ocean currents
- History of vegetation and habitat changes

Keynote Speakers

Organising committee: John Dodson, Zhengtang Guo, Roy Sidle, David Taylor, Patrick De Deckker, Yugo Ono, Zhisheng An. *Speakers include*: Wang Pinxian, Peter Kershaw, Matt McGlone, Patrick De Deckker, Simon Haberle, Wahyoe Hantoro, Fa-Hu Chen, James Shulmeister, Kate Harle, Geoff Hope, John Magee, Michael Gagan, Ian Goodwin, Ashok Singhvi, Sander van der Kaars, Weijian Zhou, Eiji Matsumoto, Takehiko Mikami, Hikaru Takahara, Julia Cole Meloth Thamban, Julie Brigham-Grette and Ryuji Tada.

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Registration Deadline: August 31st

Inside PAGES

Elke Bergius leaves the PAGES office this summer after ten months as our efficient office manager. Among her many duties, Elke was, together with Niklaus Schranz, responsible for the new and improved look of PAGES News. Elke leaves us for a managerial marketing job at a solar energy company based in Bern.

Beginning this June, Christoph Kull has taken up a 50% position as graphics coordinator at the PAGES IPO alongside continued work in the department of Geography at the University of Bern, where he received his Ph.D. (2001). Christoph has scientific expertise in climate reconstruction and glacier modeling in the Andes and will be responsible for most graphics tasks at the PAGES office.

Call for Contributions

In the next issue of PAGES News, due to appear in December 2001, we plan to highlight and overview paleoenvironmental and paleo–climate research in the mountains. This thematic issue will kick off PAGES activities in support of the UN sponsored year of the mountains in 2002. We encourage scientists from the PAGES community to submit material relevant to this theme. The deadline for submissions is November 1. Guidelines for submitted science highlights, workshop reports, and announcements can be found on our website *(http://www.pages.unibe.ch/products/newsletters.html)*.

Records of Environmental Changes in the Australian Sector of Pep II Point to Broad Trends of Climate Change

Patrick De Deckker
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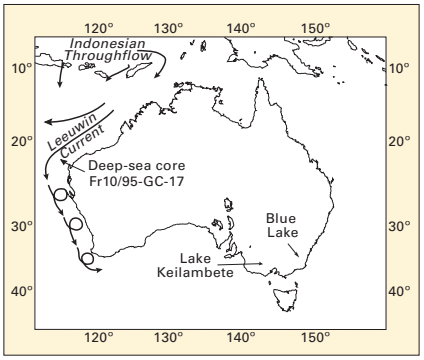
For more than 2 decades, much effort has been geared toward understanding conditions that existed in the Australian region at the Last Glacial Maximum (LGM) around 20,000 years ago. More recently, researchers have increasingly focused on identifying patterns and amplitude of climatic change since the LGM.

The excess of evaporation over precipitation, characteristic of a vast portion of Australia, renders it difficult to find lacustrine deposits suitable for the recovery of archives of environmental change. The search of such archives has thus forced researchers to investigate sites offshore in order to determine patterns and amplitudes of environmental change on the Australian continent. A core from one such site, located offshore of the north western tip of Western Australia, some 60 km from Cape Range provides a multi-proxy 30, 000 year record. Results are presented in Figure 1. The $\delta^{18}O$ record of planktonic foraminifers not only indicates a progressive sea-level rise since the LGM, but also significant fluctuations during the Holocene. These later variations result from an influx of low–salinity Pacific water via the Indonesian throughflow. This variability was intensified as a result of monsoonal activity, which commenced in the region around 14 ky ago as indicated by a decrease in the carbonate content in the core associated with the influx of terrestrial clays brought to the coring site by fluvial waters. The onset of monsoon activity is confirmed by an increase in aquatic pollen content. Mean sea-surface temperature reconstructed from foraminifer faunal analyses is surprisingly high at 11 ky, and shows a definite downward trend for the last 5 k years. This record also shows



a peak in fluvial discharge indicated by decreased carbon content and aquatic pollen changes between 8 and 7 ky. Conditions in the water column above the site are also indicated by the ratio of nannoplankton taxa *G. flabellata* and *A. robusta* (which live in the middle to the lower part of the euphotic zone) to *F. profunda* [which occur in high concentration in the euphotic zone]. The presence of pteridophyte spores in the upper

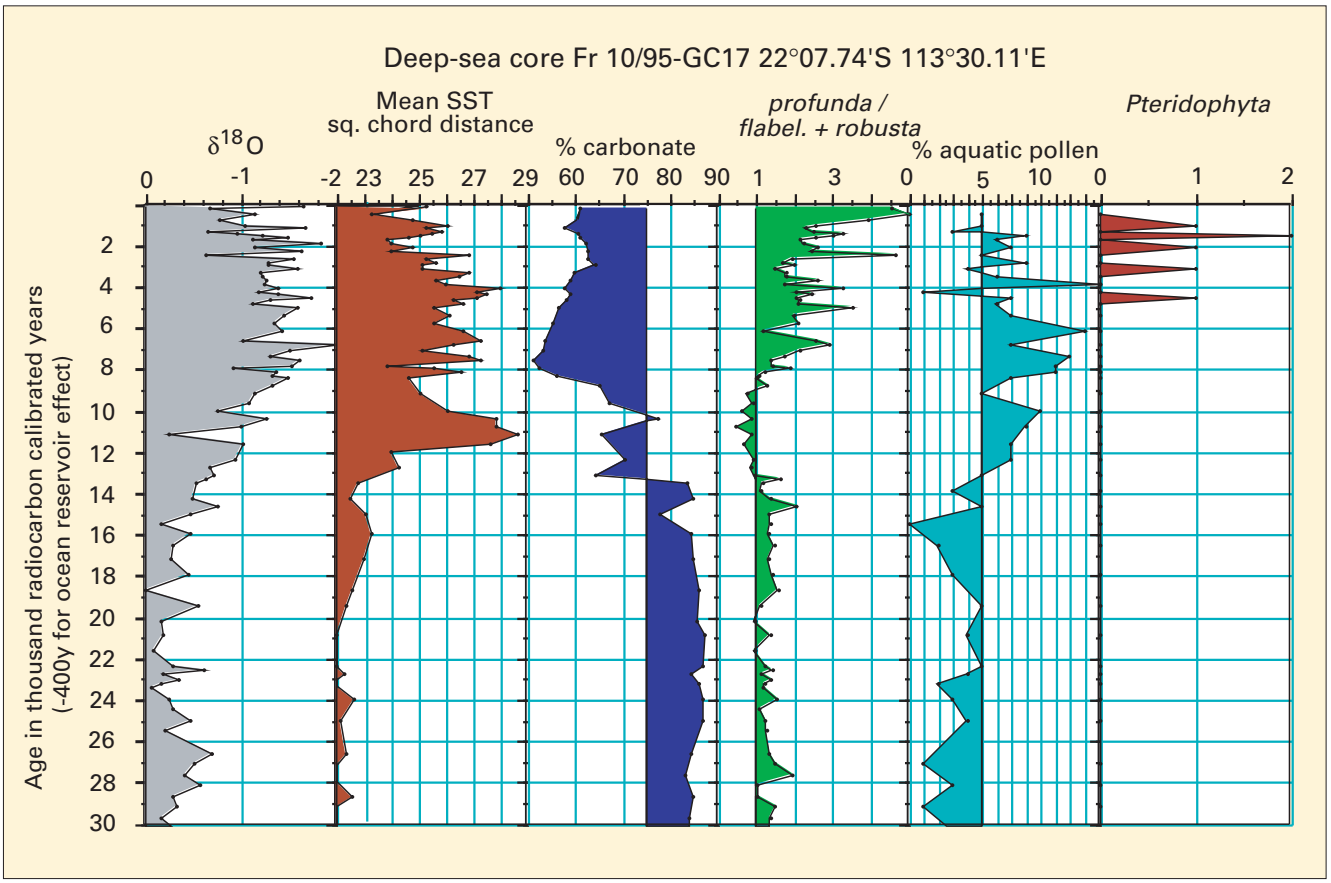


Fig. 1. Multiple lines of proxy environmental and climatic information from a marine core offshore of the northwestern tip of Western Australia

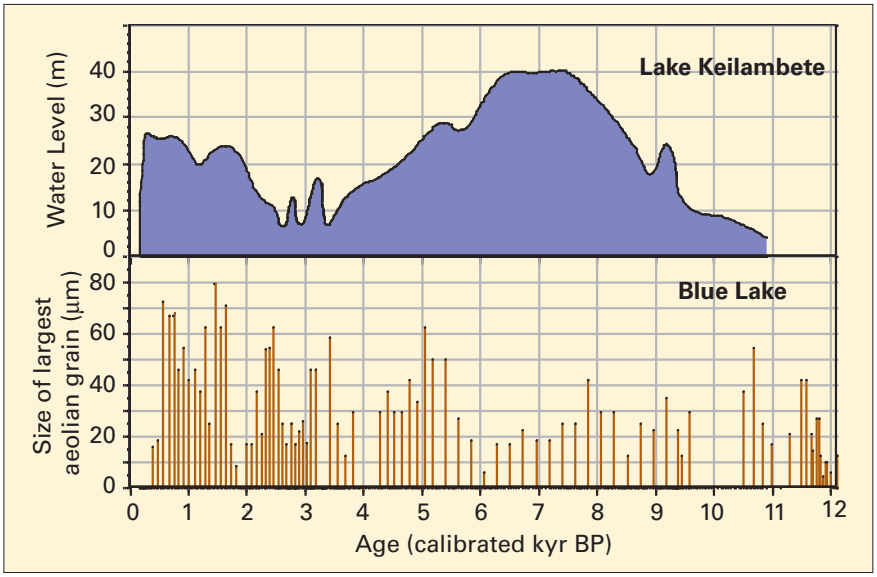


Fig. 2. Aeolian dust and lake level reconstruction from two lakes in southeastern Australia.

part of the core during the last 5 ky signifies a change in oceanic circulation in the region. At present, no pteridophytes grow in northern Australia. We therefore assume that the spores in the core originated in Indonesia or Papua New Guinea and that their presence indicates changes in the Leeuwin Current, which today travels poleward along the coast of Western Australia with an intensity significantly affected by ENSO signals (Pearce and Phillips, 1988).

Although suitable lakes for paleoclimatic reconstruction can be difficult to find, lake sediments can contribute to the understanding of climate change on shorter temporal scales. Stanley and De Deckker (in press) unravel a record of aeolian dust from the alpine Blue Lake in the Snowy Mountains of southeastern Australia and compare it to the well–documented record of lake-level changes from the crater in Lake Keilambete located to the southwest (map, Figure 2). Size analysis of the largest aeolian quartz grains found in a core from Blue Lake points to an intensification of winds or storm frequency over the last 5 ky, a period when lake levels in Lake Keilambete were both relatively low (Bowler, 1981) and variable.

The studies presented here indicate an onset of the Australian monsoon 14 thousand years ago. Furthermore, millennial scale variability in Australian climate is shown to have occurred subsequent to the Last Glacial Maximum.

Acknowlegements
Tim Barrows for SST reconstructions, Kyoma Takahashi for nannoplankton data and Sander van der Kaars for pollen data.

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An 8,000 Year Multi–proxy Record from Lake Issyk–Kul, Kyrgyzstan

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Lake Issyk–Kul is a deep, closed–basin lake nestled at 1607 m asl in the Tien Shan mountains of Kyrgyzstan (42°30–43°20 N and 76°10–78°20 E) — a valuable site along the PAGES PEP II transect from which to extract paleoclimatic information. Its deep continental interior location offers a unique opportunity to study the paleoclimate history of a climatically sensitive "amplifier" lake situated in the heart of the Asian continent positioned relatively far from monsoonal influences to the south.

The lake resides in a semi–arid continental setting between two Alpine-glaciated mountain ranges (Figure 1). Local meteorological data suggest that moisture delivered to the basin (about 100–400 mm/yr) is mostly derived from the west. Approximately 10% of the 4.6 million inhabitants of Kyrgyzstan depend upon Issyk–Kul for their livelihood. Issyk–Kul has a long history of large-scale and ongoing lake–level changes. Since at least 1856 the basin has been closed and over the same period the level has declined about 12 meters (Semenov, 1858). Considerable present-day concern arises from the recognition that the lake level has declined about 3 meters since 1926.

Little was known of Lake Issyk-Kul prior to the mid–1990's (Rasmussen and Romanovsky, 1995). Our goal over the past 4 years has been to reconstruct the Late Quaternary history of Lake Issyk–Kul. Initial results of this continuing project are reported here.

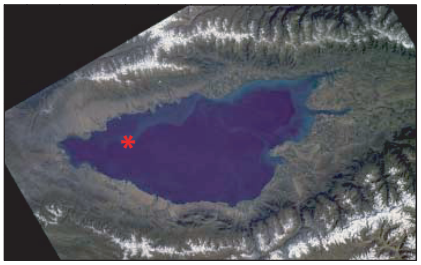

Fig. 1. Aerial view of Lake Issyk–Kul from the space shuttle (STS047–077–082, Sept. 1992) showing its position amidst Alpine–glaciated highlands of the Tien Shan. The Asterisk indicates the west–central location of core IK97–10P in 230 m water depth.

We recovered eleven piston cores from Lake Issyk–Kul in 1997. IK97–10P was selected for detailed analyses of AMS–radiocarbon age (larger ostracodes), grain size (bulk, and also carbonate-free detrital mud fraction only), sand–fraction

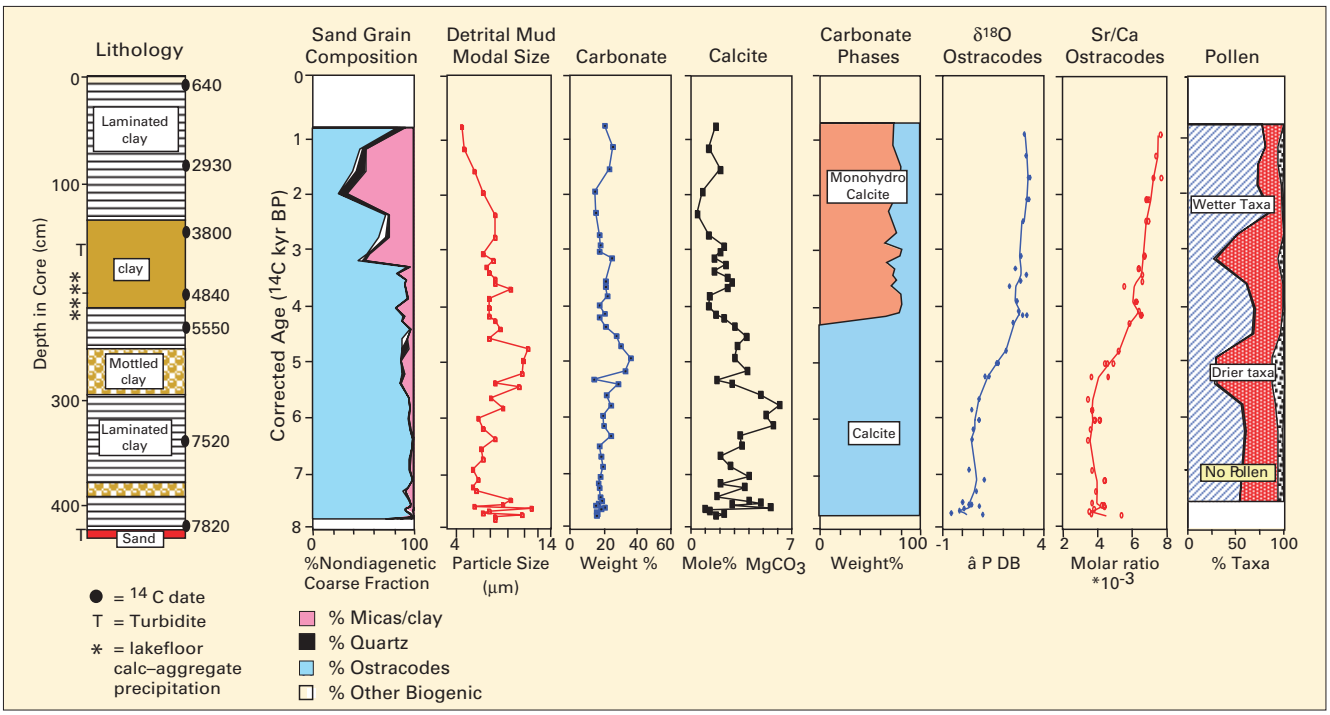

Fig. 2. Sedimentological, geochemical and palynological trends within core IK97–10P. High lake level, great distance from core to shore, and significant river inflow is interpreted from 7.8–7.5 ky — a time of highly depleted $\delta^{18}O$ values, low Sr/Ca ratios, and great variations in detrital mud particle size and Mole% $MgCO_3$. The lake was likely open, exiting westward. From 7.5-6.0 ky increases begin in detrital mud size suggesting some decrease in core-to-shore distance, the accumulation rate falls markedly (nearly 5-fold) suggesting decreasing river inflow, and Mole% $MgCO_3$ begins to increase. Conditions were apparently still open and fresh, since $\delta^{18}O$ maintains a relatively constant and depleted value near 0.5‰. Between 6.0 and 4.8 ky great and relatively rapid changes occur in our proxies which suggest a climatically–induced mid–Holocene regression, basin closure, and increased salinity. By 4.0 ky mica/quartz abundance in the minor sand–fraction has stabilized at a somewhat higher level, detrital mud particle size, %carbonate, and Mole% $MgCO_3$ have all decreased to pre–regression levels, and the rate of change in $\delta^{18}O$ and Sr/Ca values decreases. Flooding of a portion of the cobble-strewn shelf by saline waters ca. 4.3 ky seems likely, as recorded in the export of microbialitic monohydrocalcite from the shallows, detrital mud particle size decreasing to its minimum, and the greatest abundance of alluvial-source materials (mica/quartz) appearing in the limited sand fraction. A relatively high position for the still–closed lake is also supported by increased abundance of wetter (mesophytic and hydrophytic) taxa in pollen identified from the upper core. The slight increasing trend in $\delta^{18}O$ and Sr/Ca values (4.0–0.9 ky) likely reflects continued evaporative maturation of generally closed–basin lake waters similar to those found today.

constituents, %carbonate, carbonate mineralogy, stable isotope and trace element content of ostracode shells, and variations in pollen (Figure 2). This record extends from 0.64 ky at the core top (incomplete recovery) to nearly 8 ky near at its base. Sediments consist of terrigenous muds and silts along with endogenic calcite and ostracodes, as well as bacterially-induced monohydrocalcite material exported from shallow–shelf microbialite reefs (Rasmussen et al., 1996, 2000). Coeval shifts in sedimentary, geochemical, and palynological data suggest a period of generally fresh, open–basin conditions with high freshwater input from 7.8 to 6.0 ky followed by a major regressive episode and increasing salinity from 6.0 to 4.3 ky. Conditions similar to modern have existed from 4.3 to 0.9 ky (Figure 2) — a generally closed–basin, with brackish waters flooded over the shallow, cobble–strewn shelf, experiencing transient open-basin episodes.

Comparisons with other lakes suggest some similarities across the region, although more work clearly needs to be done. The record from Lake Bangong, 950 km to the south of Issyk–Kul, indicates wetter conditions between 9.6 and 6.3 ky, and increased aridity after 6.3 ky (Gasse et al., 1996). Initiation of more arid conditions occurs at 6 ky in Lake Manas 700km to the east (Rhodes et al., 1996). Lake Qinghai, 1900 km to the southeast, appears to generally experience evaporative concentration between 8.5 and 3 ky, although shorter periods of inferred lake-level rise occur within that time span (Lister et al., 1991).

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For full references please consult: www.pages–igbp.org/products/newsletter/ref20012.html

An 8000–Year Record of Typhoons in the Northern South China Sea

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Tropical cyclones in the northwestern Pacific are referred to as typhoons. We have attempted to reconstruct the record of typhoons over the past 8,000 years based on the study of inner continental shelf boreholes, archaeological, historical and instrumental records. Our study area is the Pearl River Estuary a subtropical region in the northern South China Sea.

Late Holocene Increase in Storm Beds

Six cores from seabed depths ranging from 3.8–26.2 m were studied to identify storm beds formed by Holocene typhoons. The Holocene-Pleistocene boundary in these cores was radiocarbon dated at about 8,100 yr BP (Yim, 1999). Two types of storm beds were found. First, siliciclastics–dominated beds mainly of fluvial and/or beach sands occurring in shallow water, and second, bioclastics-dominated beds formed by the resuspension of sea–floor sediment occurring in deeper water. The latter is found to possess a higher diversity of foraminifers compared to non-storm beds due to mixing of estuarine sediments and open shelf sediments during typhoons (Huang and Yim, 1997). The maximum number of storm beds found in the cores studied is seventeen (Figure 1a) representing an average of just over two typhoons per thousand years. Storm beds are relatively rare during 6,000–8,000 yr BP. This is a period of rapid change from temperate to subtropical conditions as indicated by palynological data and rapid sea-level rise of 1 cm/yr as determined from sea-level curves (Yim, 1986). Since 6,000 yr BP, with the establishment of the present subtropical climate, the frequency of typhoons has increased. However the number of radiocarbon dates is insufficient to distinguish between the ages of the storm beds in the cores. The Late Holocene (ca. 3,000 yr BP onwards) is found to show a even higher frequency of typhoons compared to the Middle Holocene.

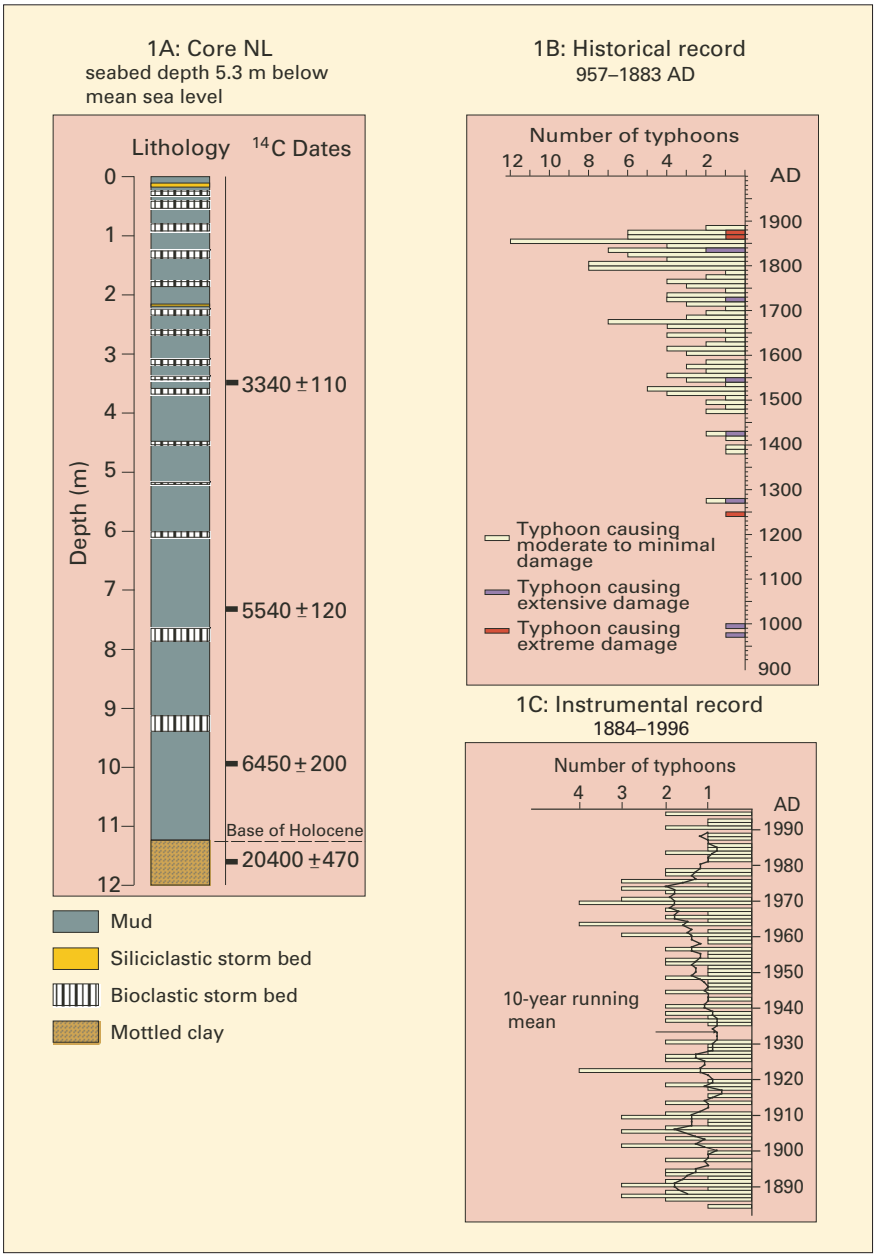

Fig. 1a: Holocene record of storm beds from Core NL (located in 2). 1b: Historical record of typhoons from 957–1883 AD. 1c: Instrumental record of typhoons from 1884–1996.

Increase in Typhoons Since 1500 AD

Historical documentation of typhoons is available in southern China for more than one millennium mainly in the form of county chronicles (Huang, 2000). Our examination of these documents during the period 957–1883 AD (67–993 yr BP) has revealed 160 typhoons. Based on the number of counties affected, the damage to crops and dwellings, and the death toll, these typhoons are classified into three categories (Table 1). The three most disastrous typhoons occurred in 1245, 1862 and 1874 AD. These have all resulted in death tolls exceeding 10,000 and the flooding of a total land area exceeding 15,000 km^2. The frequency of typhoons during the period 957–1883 AD is shown in

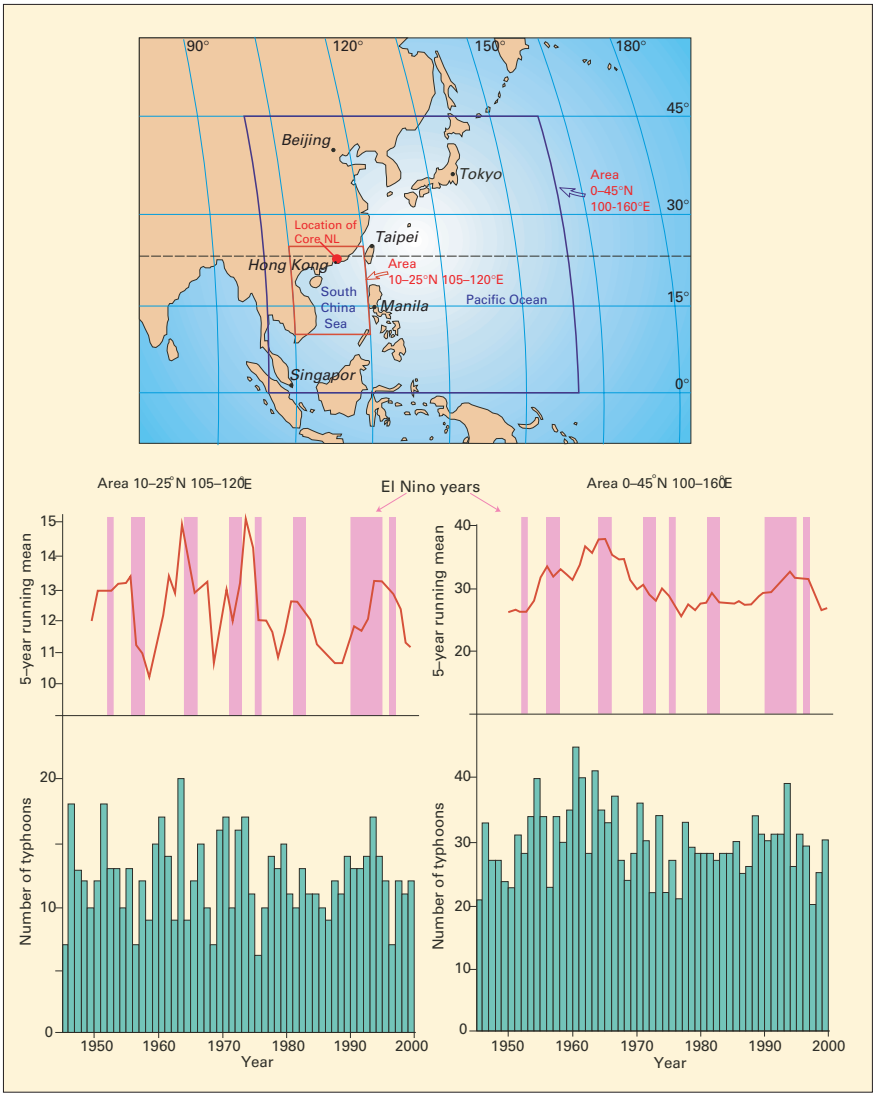

Fig. 2. Frequency of typhoons in the South China Sea and the northwestern Pacific in the two areas 10–25°N 105–120°S and 0–45°N 100–160°E during 1946–2000. Based on data collected by the Hong Kong Observatory.

Figure 1b. In this record, the number of typhoons increased sharply after 1500 AD. Although this increase is possibly related to greater typhoon damage through population growth in the region, the fall in frequency of typhoons during the Little Ice Age (ca. 16th to early 19th century) and the subsequent rise indicates that frequency of typhoons in this record is likely to be linked to climatic factors rather than to population growth.

The instrumental record of typhoons of the Hong Kong Observatory for the period 1884–1996 AD was analysed. A total of 132 were found to pass within a 150–km radius of central Hong Kong with an average frequency of ca. 1.2 times/yr. The typhoon frequency shows a period of maximum activity between 1960 and 1970 (Figure 1c). The instrumental record of typhoons frequency in the South China Sea and the northwestern Pacific during 1946–2000 is shown in Figure 2. During this period, typhoons entered the South China Sea, about 12 times per year. The 5–year running mean shows a decadal cyclicity with lower typhoon frequencies associated with the occurrence of El Niño years. Looking at the entire northwestern Pacific region, shows a weak peak in typhoon activity for the period 1954–1969.

Category	No, of countries affected	Damage	No. of typhoons
I	<4	Moderate to minimal damage to crops and dwellings; death toll < 100	149
II	5-8	Extensive damage to crops and dwellings; death toll between 100–1000	8
III	>8	Extreme damage to crops and dwellings; death toll of above 10 000	3

Table 1. Classification of typhoons in the Pearl River Delta region based on historical records from 957 to 1883 AD.

Conclusions

In comparison to the modern instrumental record, it seems likely that shelf cores record less than 5% of typhoons. This incompleteness of the record is mainly due to post-depositional reworking. Coral palaeoclimatology may be helpful in providing the missing record if they possess a long history of growth.

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For full references please consult:
www.pages–igbp.org/products/newsletter/ref20012.html

New Ice Core Database

A partnership between the Antarctic Glaciological Data Centre (funded by NSF), the World Data Centre for Paleoclimatology and the International Ice Core Data Cooperative had lead to the creation of a new Ice Core Data Gateway which utilizes a website *(http://www.ngdc.noaa.gov/paleo/icgate.html)* to increase the visibility (and use) of many data sets, greater access to data across scientific disciplines and an organized, long–term data archive.

Millennial–Scale Oscillations of Loess Weathering over the Last Glacial Period

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The loess–soil sequence in the loess plateau region of northern China documents a continuous climate record showing past changes in the East–Asian summer and winter monsoon circulations. Grain–size data from the eastern and western Loess Plateau suggest that the winter monsoon experienced millennial–scale changes over the last climatic cycle correlated with those recorded in the icecores and ocean sediments from the circum-North Atlantic region. Here we report on a high–resolution paleoweathering record from the central loess plateau covering the last 73 ky using the ratio between the CBD (citrate–bicarbonate–dithionite) extractable free Fe_2O_3 (FeD) and total Fe_2O_3 (FeT). The ratio, which we express as a percentage, is a measurement of the quantity of iron liberated from iron–bearing silicate minerals by chemical weathering relative to the total iron available. Since chemical weathering in the region mainly depends upon summer precipitation and temperature, weathering intensity primarily reflects changes in the East-Asian summer monsoon.

Figure 1 shows the variations of the loess weathering intensity over the last 73 ky. Samples were analyzed at 2.5 cm intervals over a total thickness of 9.80 m. The time–scale is obtained by correlating the loess stratigraphic boundaries with the marine SPECMAP $\delta^{18}O$ record (Imbrie et al., 1984), then interpolating with Kukla's susceptibility age model (Kukla et al., 1990). The results show that glacial weathering intensity was much weaker before the Holocene. A series of millennial-scale FeD/FeT ratio oscillations overlies the slow glacial-interglacial trend. These changes are not necessarily recorded by magnetic susceptibility, which has been used as a proxy of the summer monsoon in earlier studies. This suggests that the FeD/FeT ratio is a more sensitive proxy for rapid climate variations than magnetic susceptibility. Over the last glacial period, general agreement

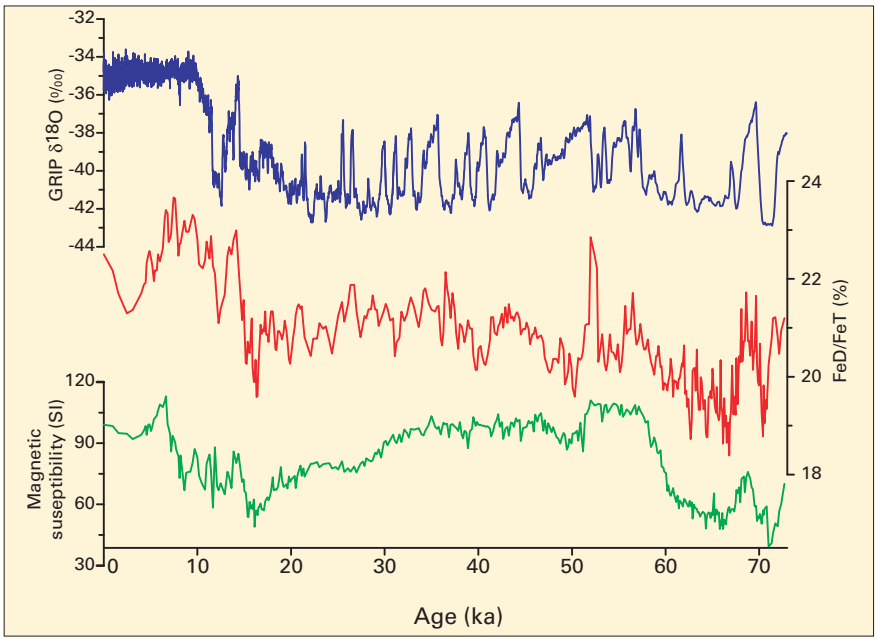

Fig. 1. Comparison of the GRIP $\delta^{18}O$ record with FeD/FeT ratios and magnetic susceptibility of the Changwu loess-soil sequence (The FeD/FeT timeseries is a 3–point moving average curve).

can be observed between the loess weathering record and the GRIP ice $\delta^{18}O$ record (Dansgaard et al., 1993). This method of dating by correlation is the current state of the art in loess reasearch. Radiocarbon has shown to be unreliable due to uncertain origin of carbon particles. Pollen and phytolith dating also give controversial results. The thermoluminescence method gives ages with potential errors of about 10–20 ky. Thus, we cannot make a cycle-by-cycle correlation between the loess weathering record and the ice-core records due to lack of absolute chronology in the loess record. However, we do believe that the loess record is accurately revealing the presence of millennial scale climate variability.

Our results indicate that millennial scale changes in the summer monsoon circulation occured during the last glacial period. The Younger Dryas event at 12.5 ky BP and the preceding warm period appear to have counterparts in the loess weathering timeseries. The dry–cold interval at 70.6 ky BP is clearly indicated by both the FeD/FeT timeseries and magnetic susceptibility. The conditions during this interval seem to have been particularly severe and to have influenced much of the loess plateau region. This dry-cold interval was immediately followed by a warm-humid interval centered at ~69 ky BP. Thus there appear to have been a two-step transition from the last interglacial stage (marine $\delta^{18}O$ stage 5) to the glacial period (marine $\delta^{18}O$ stage 4).

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The Chinese Maar Drilling Programme
A Chinese–German Cooperation for Paleoclimatic Reconstructions

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Over the last ten years, interest in high resolution (decadal to annual) paleoclimatic studies has grown rapidly. The climate system contains numerous processes on subdecadal time scales, for example the "North Atlantic Oscillation" (NAO) and the "El Niño–Southern Oscillation" (ENSO). In order to capture such modes, it is necessary to investigate paleoclimate with annual resolution. A broad range of high resolution paleoclimatic records with annual or subannual resolution (e. g. ice cores, corals, and tree rings) are available for the late Holocene. Further back in time the records are scarce.

In contrast, continental records of annual to seasonal resolution are available in maar lakes as far back as 101 ky (Lago Grande di Monticchio, Italy, Allen et al., 1999, Brauer et al., 2000). Even large lakes can contain excellently varved records (Ken–Tor et al., 2001). The Chinese Maar Drilling Program was established in order to target these records in East Asia. To date, coring campaigns have been organized in south and northeast China (Projectl & II, Figure 1).

The Huguang Maar record from South China documents the last 78,000 years. Unfortunatly, this paleorecord was not varved but it was none the less possible to establish an age model based on AMS^{14}C data and high resolution paleomagnetic measurements. The chronology is sufficiently robust to allow comparison with the marine sequence of Blake Outer Ridge (Nowaczyk et al., 2000).

Figure 2 reveals the climate change reconstructed in this record since Marine Isotope Stage (MIS) 5a. The Younger Dryas is marked by a peak in inorganic carbon and smaller amounts of organic carbon (Mingram et al., 2001).

Initial short and freeze cores in Sihailongwan maar in Northeast China provide an annually resolved record covering the last Millennium. Pollen records show no indication of a Little Ice Age.

Fig. 1. The Chinese Maar Drilling Programme. Maars and volcanic fields in China and map and picture of Huguang Maar Lake.

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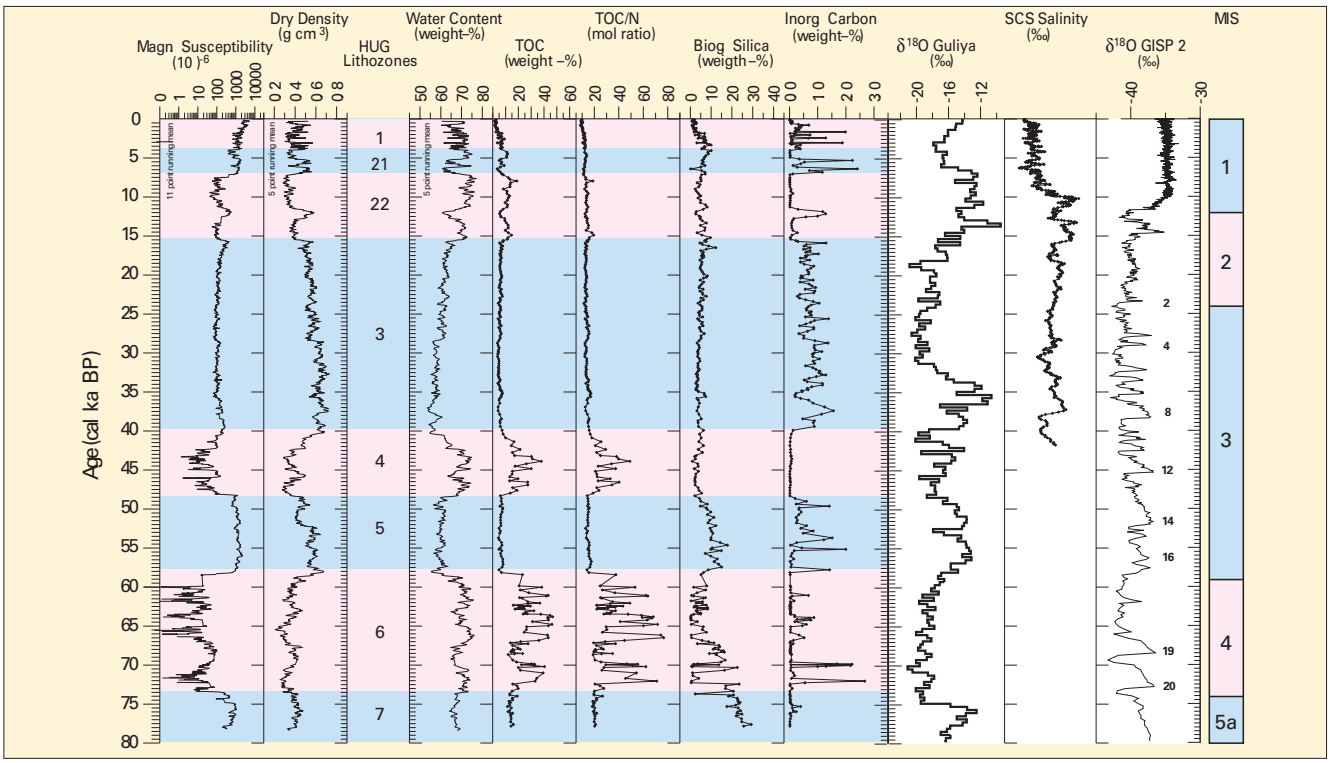

Fig. 2. Comparison of lake sediment data from Huguang Maar, ice core data from Guliya Ice Cap (Thompson et al., 1997) and Greenland (NOAA-Greenland Ice Core CD-ROM), and sea surface salinity data from the South China Sea (Wang et al., 1999).

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Pollen Records of the Last Glacial Cycle in the Southern Hemisphere Tropics of the PEPII Transect

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There is increasing interest in the role of the tropics, especially the maritime continent at region centred on Indonesia, in the search for a fuller understanding of global climate change. In addition to its importance as the 'boiler–box of the world', this region is a major player in both El Niño–Southern Oscillation (ENSO) variability and the Asian-Australian summer monsoon system. The critical location of the region in relation to the Indonesian Throughflow section of the thermo-haline conveyer belt provides it with the potential to alter both atmospheric and oceanic global circulation systems.

Due to perceived difficulties in working within lowland humid ecosystems, it is only recently that intensive and sustained research has been undertaken on the region as a whole. The potential for continuous, high resolution palaeoecological records from an abundance of sediment–filled volcanic craters on land and deep troughs between the many island systems is enormous. These sites allow comparison between environments on land and in the ocean and, in the case of pollen, comparison of local and regional vegetation histories with good chronological control provided by oxygen isotope data from the ocean records.

Summary pollen records from paired terrestrial and marine sites in Indonesia and northeastern Australia for the last glacial cycle are shown in Figure 1. These represent four of the seven long pollen records covering the last one to three glacial cycles prepared from this region to date (Figure 2). The West Java record is a compilation of the lower montane diagram from the Bandung Basin (van der Kaars and Dam 1995) with the LGM and Holocene filled in by

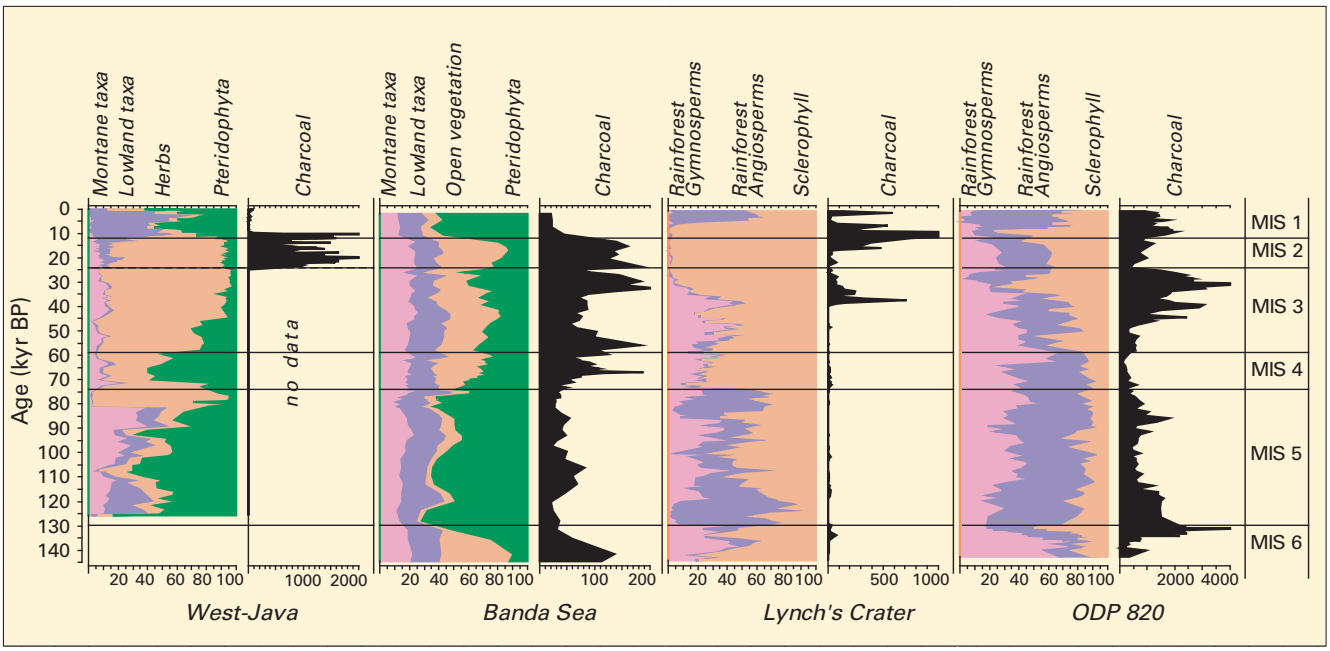

Fig. 1. Summary pollen and charcoal records of the last glacial/interglacial cycle from terrestrial and marine cores in the Australian region.

the lowland record from Rawa Danau (van der Kaars et al. in press, van der Kaars in prep), while the Banda Sea record is from van der Kaars et al. (2000). The last glacial cycle of the terrestrial Lynch's Crater record and marine ODP 820 record have been compiled by Moss and Kershaw (2000). All records are derived from, or are adjacent to, areas naturally supporting rainforest given a mean annual precipitation of at least 2000 mm. The chronologies applied to the originally published records have been retained here but are amenable to some modification.

All records show that there has been marked climate change over the last glacial cycle. The degree of replacement of rainforest (montane, lowland and pteridophyte taxa) by herbaceous vegetation in Indonesia and by eucalypt (sclerophyll) woodland in Australia during glacial periods MIS 6 and 4–2, suggests precipitation was reduced by some 30–50%. The terrestrial records suggest that during these periods rainforest may have had a very restricted distribution. However, the marine records indicate more substantial rainforest survival. The precipitation signal is much more evident than that for temperature, although a 6°C reduction for the LGM at submontane altitudes in Java is inferred.

Charcoal records indicate that burning has been a feature of wet tropical environments through at least the last glacial cycle, with fire activity generally higher during drier glacial periods. The data from the terrestrial records though, suggest that fire within rainforest has been very limited. All records show some sustained change in vegetation. Examples include the replacement of gymnosperm-dominated drier rainforest by sclerophyll vegetation in Australia and by reduced representation of *Dipterocarpaceae* in the Banda region, that might be associated with increased burning levels between about 50,000 and 35,000 years ago. In the absence of evidence for significant global climate change at this time, these changes have been attributed to the impact of humans as they spread through this region. However, the apparent impact in Australia before Indonesia, based on recent AMS redating of the Lynch's Crater record and evidence for similar sustained changes at the end of MIS 6 in the ODP 820 record, well before archaeological evidence for people, makes a solely human cause improbable. Instead, the possibilities of environmental changes caused by alterations to ENSO and monsoon activity, as a result of tectonic and volcanic impacts on the Indonesian Throughflow, are currently being investigated.

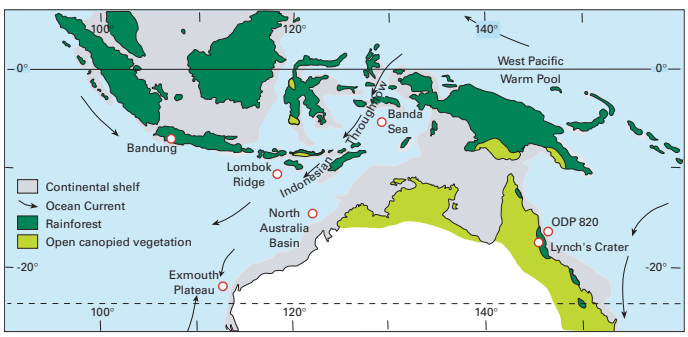

Fig. 2. Location map of long Quaternary pollen records .

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East Asian Monsoon Signals Recorded in the Japan Sea Sediments

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East Asia is the region where the warm-humid summer south-east monsoon and the cold–dry winter northwest monsoon meet. Both monsoons are subsystems of the large-scale heat and moisture exchange between northern and southern hemisphere (An, 2000). Because marginal seas located at the eastern edge of Asian Continent record both monsoon variations as well as how oceanic circulation and ecosystems have responded to these climatic variations, they are key archives in the PAGES–PEP II transect.

Variations in the East Asian Monsoon

The Japan Sea is a semi–enclosed marginal sea located between the eastern margin of the Asian Continent and Japan. Because of its semi-enclosed nature, the Japan Sea has responded sensitively to variations in the East Asian monsoon and related oceanographic changes. The sediments in water deeper than 800 m are characterized by alternating centimeter to decimeter scale of dark and light colored layers (Figure 1). These layers can be correlated widely within the Japan Sea (Tada et al., 1992). The occurrence of dark layers is associated with interstadial periods in Dansgaard-Oeschger (D–O) cycles except for the one corresponding to LGM that was formed under stratified conditions due to isolation of the Japan sea and consequent decrease in the surface water salinity (Dansgaard et al., 1993; Tada et al., 1999). Dark layers during oxygen isotope stages 3-5 are characterized by 1) higher organic carbon content, 2) diatom assemblages indicating lower salinity surface water, and 3) pollen assemblages showing relatively warmer, wetter conditions compared to light layers (Tada et al., 1999; Ikehara et al., 1994). These multiple lines of evidence suggest that stronger summer monsoon precipitation in East Asia resulted in a higher supply of fresh water and nutrients from land to coastal water in the East China Sea. This would lead to lower salinity and higher primary productivity in the surface water of the Japan Sea and dark layer sediments with higher organic carbon content. Freshwater would also result in weakened ventilation of the deep water, thereby enhancing organic carbon preservation during dark layer deposition.

Therefore, these record suggest that the East Asian summer monsoon precipitation varied in association with D–O cycles.

A Possible Extreme Cooling Event

Japan Sea sediments have also recorded another kind of paleoceanographic variation. In a sediment core from St. 1246 taken during the GH99 cruise held by the Geological Survey of Japan in summer 1999 (Figure 1), we find not only the dark-light cycles described above but also frequent intercalation of thin (<1cm) pale green layers. These pale green layers occur frequently within both dark and light layers in the interval between oxygen isotope stage 3 and late stage 5. They often contain gravel which was likely to have been transported by sea ice. In the deeper part of the Japan Sea, pale green layers frequently occurred during glacial times. At intermediate depths, their formation was less frequent during stage 3.
In the shallow waters, no pale green layer formation occurred. These facts suggest that the formation of these pale green layers could be related to centennial-scale events associated with the variation in bottom water circulation and the sea ice expansion during the glacial period, which occurred during both stadials and interstadials. These events may have been related to changes in the winter monsoon circulation, and show no significant correlation with D–O cycles.

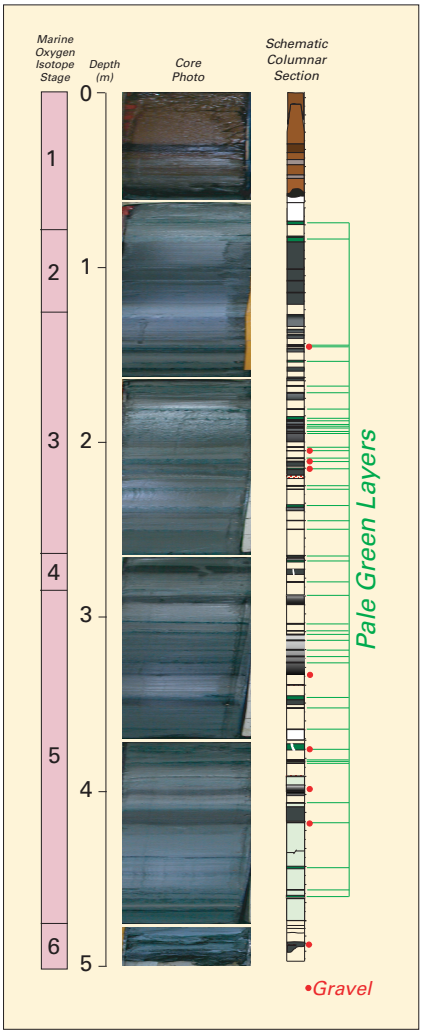

Fig. 1. Appearance of typical Japan Sea sediment core (GH99–St. 1246). Horizons of pale green layers and gravel occurrence are shown. Approximate positions of marine oxygen isotope boundaries are also shown using the age model established by Tada et al. (1999).

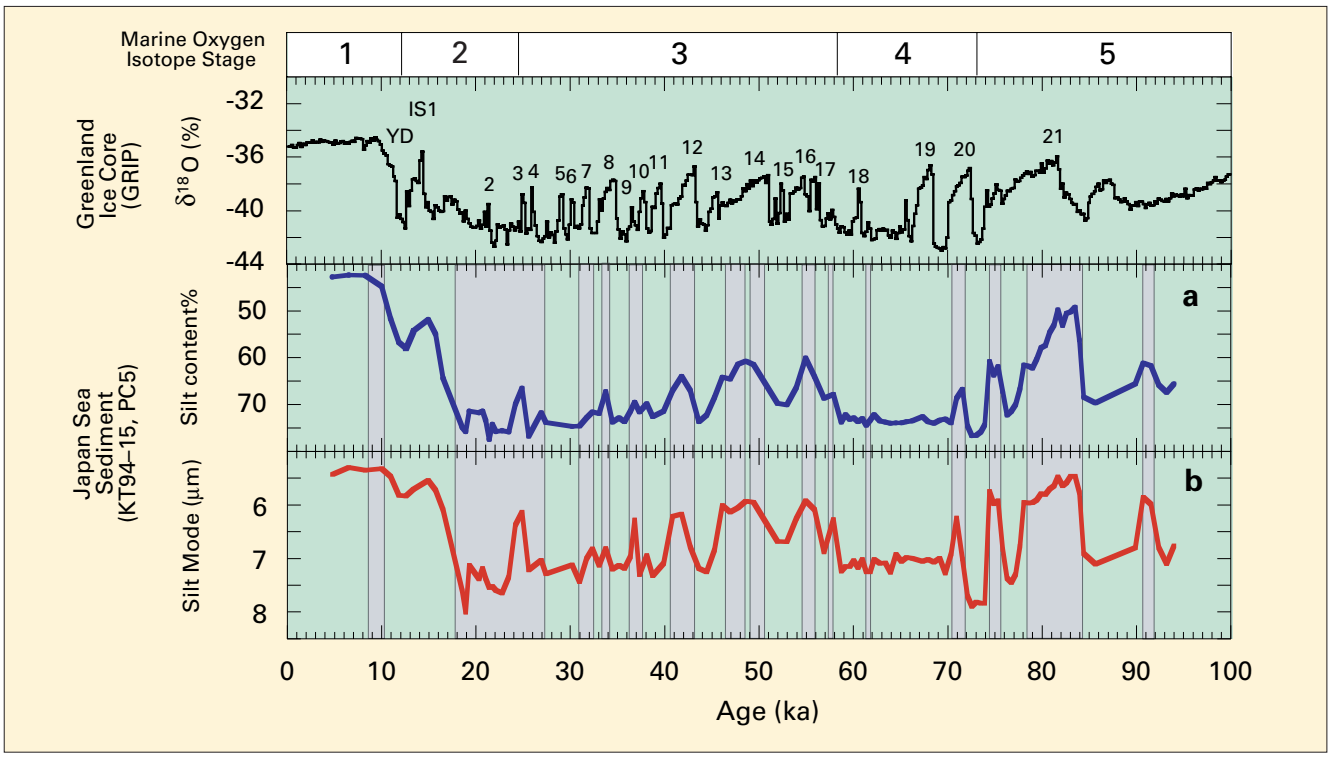

Fig. 2. Temporal variations of aeolian dust (silt) content (a) and grain size (b) in core KT94–15-PC5 recovered from the Japan Sea. The gray area indicates the position of dark layers. Oxygen isotope variations from GRIP ice core are also shown for comparison .

Variations in Aeolian Dust

Japan Sea sediments also recorded variations in aeolian dust supply because of the Sea is located just downwind the arid Central Asian dust source area (Irino and Tada, 2000). We have analyzed chemical and mineral composition of hemipelagic sediments from selected locations. Our results show that the sediments consist of two detrital subcomponents, which are attributed to aeolian dust and detrital materials derived from the Japan Arc, respectively. Further evaluation of detrital grain size distribution and chemical composition of the KT94–15–PC5 sediment core reveals that the silt size fraction (~6 μ m) within Japan Sea sediments consists almost entirely of aeolian dust and the clay size fraction (~3.5 μ m) consists primary of Japan Arc derived detritus (Tada et al., 2000). Temporal variation of aeolian dust (silt) content in the Japan Sea sediments shows millennial scale fluctuations coincident with dark-light cycles (D–O cycles). Silt content is lower during the dark layer deposition except during the LGM (Figure 2a). This fact suggests that a humid-arid cycle associated with summer monsoon variability in East to Central Asia resulted in variations in dust availability from Central Asia and/or riverine supply from the Japan Arc. Aeolian dust (silt) grain size also shows temporal variations associated with D–O cycles, with grain size being smaller during dark layer deposition except at the LGM (Figure 2b). Both silt content and mode indicate an intensification of dust supply around the LGM. Such dust can be transported by winter monsoon winds and westerlies (Ono et al, 1998). Our results therefore suggest that the winter monsoon and westerlies vary in harmony with D–O cycles.

Do the winter and summer monsoons vary independently?

Recent progress in paleoceanographic and paleoclimatic reconstructions provide consistent evidence that summer monsoon precipitation in East Asia varies with D-O cycles. In the case of winter monsoon, a discrepancy between fluctuation patterns of some proxies such as sea ice extent and aeolian dust grain size is recognized. Porter and An (1995) showed that magnetic susceptibility, a summer monsoon indicator in loess sequences, has a different pattern of fluctuation than quartz grain size (a winter monsoon indicator). It is not clear if this discrepancy is of a hemispheric scale significance or represents a local response of the Japan Sea. In order to solve such problems, it is necessary to compare multiproxy, independent summer and winter monsoon signals derived both from terrestrial and oceanic records.

Understanding linkages between the East Asian monsoon and weterlies is another important topic to be addressed in the context of the PEP II transect.

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CLIWOC: a Cooperative Effort to Recover Climate Data for Oceanic Areas (1750–1850)

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Logbooks and Climate

Since at least the time of Christopher Columbus mariners have kept logbook accounts of their voyages. As well as acting as a diary one of the principal functions of a logbook was to assist in safe navigation. This was especially important when ships were out of sight of land and had no easy points of reference with which to determine their position. By 1750 the keeping of logbooks was almost universal amongst the officers on European ships. Although not prepared with this purpose in mind, the logbooks and the detailed observations that they contain are today of great scientific value.

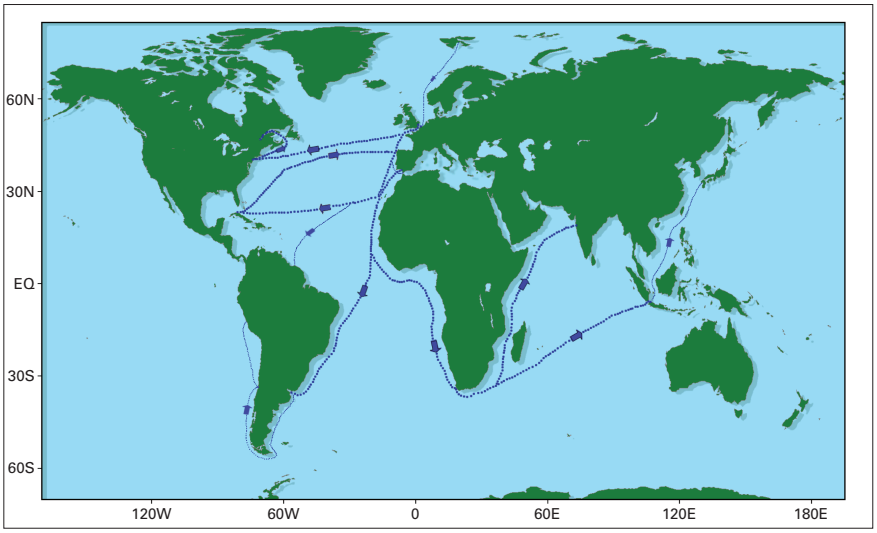

Fig. 1. Most frequented routes during the CLIWOC period.

Navigation became a precise science only in the nineteenth century. Before that time more approximate methods had to be used. These all required that wind force and wind direction be carefully recorded, in order to help determine the drift, or 'leeway', made by the ship. Mariners tended also to keep a careful note of other weather phenomena such as rain, thunder, fog and snow even though they had little direct influence on navigation. It is possible to gain an appreciation of the huge volume of climatic data held in the logbooks when it is recalled that observations on the weather were made several times each day whilst the vessel was at sea.

Many logbooks failed to survive the rigorous of life at sea but several thousands have survived intact to the present day. A few date from as long ago as the seventeenth century. Most frequent amongst the survivors are the logbooks of vessels in the state service of imperial nations and in particular those of the naval services. These have now been gathered together in a number of national archives.

The recovery of climate data contained in those logbooks can quantitatively improve our understanding of climate variability on the decadal to century time scales. This source is of particular interest because it covers a period of time (seventeenth century onwards) and regions (the oceans) for which detailed data are scarce and difficult to obtain by other means. These benefits notwithstanding, the abstraction and collation of these data into a coherent and scientifically useful body of information is both challenging and time-consuming. Currently there are a number of projects aiming to obtain climatic information from observations contained in logbooks from different national navies (eg. Díaz and Woodruf 1999).

The CLIWOC Project

CLIWOC (Climate Database for the World Oceans) is a project funded by the European Union (January 2001 to December 2003). The principal objective is to realize the scientific potential of logbook climatic data and to produce a database of daily weather observations for the world's oceans between 1750 and 1850. Importantly this database will be freely available to the scientific community. Other objectives are a) to contribute to the understanding of the nature of climatic change over the oceans for the century after 1750 when logbooks become abundant, b) to link with existing data bases that cover the period since the middle of the 19th century, c) through obtaining detailed information from the North Atlantic region to refine our knowledge of the behavior of the NAO for a time before any marked anthropogenic influence on climate can have been made and, d) to stimulate a wider interest in the value of historical documents, but especially logbooks, in climatic research.

The CLIWOC partners are: University Complutense of Madrid (Spain), University of Vigo (Spain), University of Sunderland (UK), KNMI (The Netherlands), University of Leiden (The Netherlands), CRICYT (Argentina) and University of East Anglia (U K). Staff from CDC from NOAA (USA) and the Hadley Centre (UK) act as advisors.

CLIWOC represents one of the most important efforts in digitizing climatic data after the Maury Collection in the USA and the Kobe Collection in Japan (Manabe, 1999). Because of the time period covered by the project, most of the observations

are in qualitative, descriptive form and, in four different languages. It is the research team's aim to express as much of the data in quantitative form as can be reliably accomplished.

The final CLIWOC database will be linked to that of COADS and will include daily observations from many of the World's major oceanic areas. Figure 1 shows the more frequented sea routes of the period and, consequently, those areas where more information will be available. The data will be presented in a processed form using terms conforming to present-day usage and understanding. Information will be based on the most frequently recorded elements of wind strength and direction but data can also be provided on a wider range of commonly recorded phenomena that include rain and snow, thunder, fog and even the incidence of sea ice cover. To render the database more manageable, annual and decadal summaries will be included. A meta-database will also allow users to consult the original sources.

While the primary objective of this project is the preparation and dissemination of a daily climatic database for the century 1750 to 1850, other valuable outcomes will also be achieved. Not least of these is the insight that the logbook information will give to the question of climatic change over oceanic areas. It should be emphasized that no other source provides a basis on which to examine such variation at a daily scale. This unique opportunity will be exploited to its fullest potential while not overlooking the importance of longer term trends in climatic behavior.

CLIWOC partners wish to share their experience with colleagues interested in similar research fields. A workshop is therefore planned for spring 2002 in the Netherlands to host scientists from a variety of fields: climatologists, meteorologists, historians, archivists, geographers and other academics who appreciate the role of historical documents in climatic research.

Further information about CLIWOC can be found at the project web-site: *http://www.ucm.es/info/cliwoc/*

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Paleo-Grassland Research (PGR) 2000: a Conference on the Reconstruction and Modeling of Grass–Dominated Ecosystems

Connecticut, USA, 1–3 June 2000

Since any single proxy of past vegetation often lacks taxonomic resolution and subsequent ecophysiological information, paleoecological reconstruction and modeling of grass-dominated ecosystems is reliant on the information supplied by multiple disciplines and the analysis of multiple proxies. Proficiency in a single proxy demands years of training, thus the success of a multi–proxy approach requires collaboration. The first Paleo-Grassland Research 2000 (PGR2000) workshop in Westbrook, Connecticut fostered such collaboration by bringing together over forty participants, representing twelve countries within North and South America, Europe, Asia and Africa. The primary goals of the meeting were to 1) promote inter–disciplinary collaborative research; 2) to synthesize an informed multi-proxy approach to the reconstruction of past grasslands; 3) establish a network of scientists concerned with grassland paleoecology.

Funding for PGR2000 was provided by the National Science Foundation–Paleoclimate Program and PAGES — Past Global Changes.

PAGES support allowed Aldo Prieto (Universidad Nacional de Mar del Plata, Argentina) to present research on the Pampa paleo-grasslands of Argentina, Indrani Suryaprakash (Indian Institute of Science, Bangalore) to discuss the paleoecology of montane grasslands in southern India and Mohammed Umer (Addis Ababa University, Ethiopia) to present evidence for Holocene vegetation change from Lake Tilio, an Ethiopian Crater Lake.

The meeting lasted three days and consisted of four oral sessions, each dedicated to a proxy used in the reconstruction of grass dominated ecosystems, and an interdisciplinary poster session. The size and structure of the workshop allowed delegates to attend all sessions.

Overview Session

The conference opened with an introductory session with presentations by Matthew Wooller (Carnegie Institution of Washington, USA), Thure Cerling (University of Utah, USA) and Jim Ehleringer (University of Utah, USA) who introduced some fundamental physiological features of the grass family. John Kingtson (Yale University, USA) provided a synthesis of data derived from multiple proxy evidence on the origins of grasslands, while Dan Livingstone (Duke University, USA) introduced grass cuticles, an under-utilized proxy of past grasslands, and discussed issues concerned with their taphonomy.

Pollen and Modeling Session

The second session was devoted to palynological research and included evidence from South America, including a presentation by Mark Bush (Florida Institute of Technology, USA) on Amazonian pollen sequences

A grass dominated ecosystem at high altitude (~4000 m.a.s.l.) on Mount Kenya, East Africa. Photograph taken by Matthew Wooller.

and Hermann Behling (Zentrum für Marine Tropenökologie, Germany) on Late Quaternary Brazilian grasslands. Raymonde Bonnefille (CEREGE, France) presented pollen evidence, alongside other proxies, of East African vegetation since the tertiary, while Louis Scott (University of the Orange Free State, RSA) presented pollen and charcoal evidence related to grassland development in South Africa during the Late Quaternary. Cathy Hoyt presented evidence of Late Quaternary grassland change in North America. Since pollen from different grass species is morphologically identical, the presentations by palynologists emphasized the need for additional proxies of past grasslands with which to compare pollen data.

Phytoliths Session

The particles of biogenic silica produced in the leaves of grasses, known as phytoliths, have greater morphological variation than grass pollen and are an effective resource for grassland reconstruction. Phytolith research was presented by Irwin Rovner (North Carolina State University, USA), Anne Alexandre (CEREGE, France) and Glen Fredlund (University of Wisconsin-Milwaukee, USA) during the morning of the second day. Caroline Strömberg (UC Museum of Paleontology, USA) discussed grass-dominated biomes in the late Tertiary of North America and related this to faunal evolution, complementing Bruce MacFadden's (Florida Museum of Natural History, USA) approach to reconstructing Pleistocene vegetation using evidence from the faunal record. Phytolith data was also presented by Mikhail Blinnikov (St. Cloud State University, USA) who produced a reconstruction of the late-Pleistocene grasslands of the Columbia river basin, USA and Francesca Smith (INSTAAR, USA) who provided an interdisciplinary study of stable carbon isotopes ratios preserved in fossil phytoliths.

Isotopes and Other Techniques

The final oral session allowed Alayne Street-Perrott, David Swain and Katherine Ficken to present the multi-proxy approach applied by the Tropical Palaeoenvironments Research Group (University of Wales Swansea, UK) and included results from vegetation modelling along with pollen, compound specific isotope and grass cuticle data derived from crater lakes on Mount Kenya, East Africa. Arnoud Boom (University of Amsterdam, The Netherlands) and Robert Marchant (University of Amsterdam, The Netherlands) provided bulk carbon isotopic and pollen evidence from the high plain of Bogota, South America, while Yongsong Huang (Brown University, USA) presented compound specific isotope data from Mesoamerica. Kristina Beuning (Wesleyan University, USA) presented the final talk, showing her work involving stable carbon isotope analyses of pollen.

Additional Activities

A poster session occupied part of the afternoon on the second day and allowed delegates to examine approximately twelve posters related to paleo-grassland research. Activities on the second day concluded with delegates meeting to discuss future research prospects in areas of common geographical interest. Students from Wesleyan University, including Jessica Scott, Rehanna Chaudhri and Festo Lugolobi assisted throughout the conference. The meeting concluded with an open discussion on the future of Paleo–Grassland Research. Perfect weather conditions, booked by the organizers, allowed the meeting to end with a beautiful sunset observed from aboard a 32ft Schooner sailboat on Long Island Sound.

Outputs

The primary outcomes of this workshop are: 1) a forthcoming collection of peer–reviewed articles to appear in Palaeoclimate Data and Modelling, documenting research involving the current state–of–the–art techniques for paleo–grassland research; 2) a PGR 2000 website *(http://www.wesleyan.edu/~kbeuning/PGR2000)*; 3) a listserver to facilitate collaboration by keeping members of various disciplines and geographic regions connected (to subscribe contact kbeuning@wesleyan.edu); 4) plans for a future meeting in 2002 to be held in either India or Texas, USA ; 5) the formulation of the Paleo-Grassland Research Association (PGRASS): a working group aiming to reconstruct global grassland evolution and response to climate, herbivory, fire and human activities

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The 6th ELDP Workshop: High–Resolution Lake Sediment Records in Climate and Environment Variability Studies

Potsdam, Germany, 11–16 May 2001

The European Lake Drilling Programme (ELDP) is an ESF (European Science Foundation) Scientific Programme aiming a better understanding of the regional dimension of past environment changes in Europe through high–resolution lake sediment studies (see PAGES newsletter Vol. 7, No.1, 1999). The Potsdam workshop was the last of a series of annual workshops on special themes concerning interpretation and correlation of European lake records which began in Strasbourg in 1996. The concept of the Potsdam workshop was to combine a summary of results achieved in ELDP, including answers to key questions raised by the programme, with a discussion about perspectives for future research. The workshop began with summaries of the four regional (Northern, Central, Southern Europe, Atlantic) and one thematic (Extraterrestrial forcing in palaeoclimate archives) working groups which have been established within ELDP. These summaries provided an overview of the scientific progress made in the last five years of ELDP and were followed by 6 thematic sessions with 28 contributions from participants from 12 European countries and Israel. In the first session, "Indications of solar forcing" $\Delta^{14}C$ variations and their link to the ^{14}C production rate as well as their effects on climate and environment were discussed using examples from the late and early Holocene. In the session "Holocene climate variability" complex environment changes during the early Holocene in central and southern Europe were reported. There is increasing evidence that palaeohydrological changes occurred even in Central Europe and that the reconstruction of variations in precipitation, although difficult to achieve, requires further attention. The key question addressed in the session "Human and climate interactions" was the connection between cultural and climatic changes in NW Europe. An interesting approach was presented with the detailed comparison of vegetation development, influenced by both climate and man, along a West–East transect from Germany to Poland based on precise correlation of varve–dated lake records. This example demonstrated the high potential for reconstructing spatial variations of climate change with detailed correlation between lake records, one of the main foci of ELDP. Further progress in establishing a network of linked high-resolution sediment records were reported in the session "Advances in correlation". It was clearly demonstrated that annually laminated records such as the one from Lago Grande di Monticchio, Italy, will play a key role in dating and correlation. Complementary techniques including the use of tephra layers and paleomagnetic variations have been further developed in recent years providing "hard" time markers which obviate the need for wiggle matching of climate signals. It is now possible not only to correlate between lake records but also to include marine records. Based on a tephra layer (Naples Yellow Tuff) Mediterranean records can now be linked to a southern Alpine site at least for the Lateglacial. As a result, networks of correlated palaeoclimate archives have been established for the regions south and north of the Alps. Further sessions concentrated on "Responses of lake ecosystems" with examples for the range of possible interpretation of sediment signals in lake records, and, on "Methods" where methodological problems and advances in interpretation of isotope signals were discussed. The danger of uncritical use of radiocarbon dates in establishing chronologies was demonstrated as well as a new approach for oxygen isotope analyses on diatom valves, an important tool in carbonate–free lake sediments.

During the last day of the workshop future perspectives were discussed in two sessions. At first, the urgent need to merge the "palaeo–community" which produces proxy data with climate modellers was demonstrated by the example of the German "Strategiefondsprojekt" KIHZ (Natural climate variations of the last 10,000 years: *'http://www.gfz-potsdam.de/pb3/pb33/kihzhome/kihz00/welcome.html'* launched in 1998. One presentation concentrated on how to make proxy-data "digestible" by climate models, i.e. how to use these data to drive climate models. In the second session the idea of a regional extension of ELDP into a continental West-East transect including Asia was introduced with examples of high–resolution lake records from Russia, China and Japan. Such a transect would be an ideal complement to the PAGES North-South PEP transects.

In between the "Summary" and "Perspective" parts of the workshop a field trip was organised to view morphological and sedimentary evidences of a Weichselian ice advance in northern Brandenburg (Pommeranian Stage).

An extended abstract volume has been published as Terra Nostra 2001/3 " High–resolution lake sediment records in climate and environment variability studies (ISSN 0946-8978) and can be ordered online from the Alfred-Wegener-Stiftung *(http://kihz.gfz-potsdam.de).* More information about the Potsdam and previous ELDP workshops is available from the ELDP homepage at *http://www.gfz-potsdam.de/pb3/pb33/eldphome/.*

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Highest II: Climate Change at High Elevation Sites: Emerging Impacts

Davos, Switzerland 25–28 June 2001

5 years after the meeting Highest I: Climate Change at High Elevation Sites) 50 scientists from wide ranging interdisciplinary backgrounds met with the goal of synthesizing climate change impacts on ecosystems and humans at high altitudes. To open the meeting, Bruno Messerli underscored the importance of mountains as "water towers" supporting the needs of a sizable fraction of humanity.

This typical Alpine meadow in the Sertig Valley is a classical example of a human dominated mountain ecosystem. In the background is Sertigdorf, a small village. A short, but steep, bike ride out of Davos. Photo: Keith Alverson

One topic of discussion was quantifying and understanding the ongoing retreat of mountain glaciers worldwide, as exemplified by the case on Kilimanjaro shown on the cover on this newsletter. Debate about Kilimanjaro's glacial retreat centered around whether this indicated increasing local ambient temperatures and increased long wave radiation from the dark caldera surface (higher melt rates) or increased short wave radiation leading to enhanced sublimation, one possible explanation for the special perpendicular inward facing walls of these ice fields.

Further debate arose over the interpretation of $\delta^{18}O$ records in ice cores. Ray Bradley and Mathias Vuille showed records from automatic weather stations placed at the exact sites where ice cores have been recovered, and argued that the snow which lasts through the year, and is thus incorporated in the ice cores, comes from a short seasonal timewindow. As a result $\delta^{18}O$ would be expected to show a strong relationship to monthly variability in precipitation source and amount. Lonnie Thompson countered that these two years of data may provide some insight, but not on decadal and longer timescales. On these longer timescales the isotopic shifts in many of these cores are almost exactly the same as those from Greenland, arguing that the isotopes are indicating, in both locations, hemispheric scale temperature variability. Ulrich Schotterer showed that climatic interpretation of ice cores especially in arid regions as the Central Andes may be difficult due to the fact, that mass losses by sublimation both concentrates chemical species and reduces net accumulation dramatically.

Another topic of discussion was mountain ecosystem changes in recent years. Pavel Moiseev, one of three PAGES funded participants from developing countries, showed a stunning series of photographs from early in the century compared with the same locations during the last few years. Vegetation belts, and in particular treeline, has moved tens to hundreds of meters along the full north south extent of the Ural mountains. Discussion ensued about the reasons for these, and similar shifts in other parts of the world. Both pollen (Sonja Hausmann) and numerical models (Harald Bugman) clearly indicate that in heavily populated and intensely used mountain areas such as the Swiss Alps, tree line is largely determined by human land use practices, and has been for thousands of years. However in the Ural's and other remote ranges, these changes are not due to direct human influences. The question of CO_2 fertilization vs climatic amelioration as possible drivers of these ecosystem changes was debated. Christian Koerner argued emphatically and convincingly that temperature, not photosynthetic efficiency, in general determined treeline elevations, with other processes such as moisture availability playing roles on regional scales. Interesting and important feedbacks also come into play, for example soil temperatures may warm allowing trees to expand upward or form closed canopies, but these closed stands will then shade the soil, leading to cooling of the soil and conditions no longer advantageous for the trees.

Finally, numerous presentations presented proxy records of Pacific decadal variability, from Patagonia to Alaska and attempted to quantify the magnitude and spatial expression of this climatic mode and its interaction with shorter timescale processes such as ENSO. Although the statistical nature of pacific decadal variability is clearly indicated in many proxy records, they do not always agree. Henry Diaz and Stefan Hastenrath provoked much debate as to whether this was a "real" phenomena, with a dynamical explanation, or simply a statistical querk. Alverson argued that cross correlations of the strong interdecadal signal in the accumulation record of the Mt. Logan ice core with both tropical SSTs and upper tropospheric pressure fields show a clear dynamical basis for the hemispheric expression of this teleconnection pattern in the meridional moisture transport associated with synoptic weather systems.

A special issue of Climatic Change that is being put together as a product from this meeting. The conference organizers and participants gratefully acknowledge the financial support of NOAA and the NSF in the United States, NCCR and SANW in Switzerland, PAGES, and the hosts in Davos.

CALENDAR 2001–2002

22–26 September, Tree Rings and People. An International Conference on the Future of Dendrochronology, Davos, Switzerland
Contact: Paolo Cherubini, Swiss Federal Research Institute WSL, 8093 Birmenstorf, Switzerland.
E–mail: paolo.cherubini@wsl.ch
http://www.wsl.ch/forest/dendro2001/

8–10 October , Workshop on IMAGE ANALYSIS, sediments and paleoenvironments, Amherst, USA
Contact and E–mail: francus@geo.umass.edu
http://www.geo.umass.edu/climate/imagewks.html

10–13 October , SPACC/GLOBEC Workshop on Paleoceanography, Munich, Germany
Research teams will be brought together to carry out high frequency analyses of sediment cores from different anoxic sites in order to cross-calibrate methodologies and co-ordinate future co-operation through SPACC/GLOBEC so that results from different sites can be compared. The use of fish scale deposition will be emphasized as a tool for reconstructing the variability in populations of interest to SPACC and developing proxy records of ecosystem and climate variability. Major topics are: Comparing/standardizing methologies, calibration of proxy records and site development.
Contact : Jürgen Alheit
E–mail: juergen.alheit@io-warnemuende.de

29 October–1 November, CEAPE: 5th International Conference on the Cenozoic Evolution of the Asia-Pacific Environment, Hong-Kong, China
The main theme is the paleoenvironment and the contemporary environment of the Asia-Pacific region covered by the Pole-Equator-Pole (PEPII) transect extending from the Russian Pacific region down to Antarctica. Special focus on long Quaternary records particularly during glacial cycles.
Contact: Dr. Wyss Yim, Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China and/or Prof. Jiamao Han, Institute of Geology & Geophysics, Academia Sinica, P.O. Box 9825, Beijing, 100029 China
E–mail: wwsyim@hku.hk, jmhan@public.east.cn.net
http://www.pages-igbp.org/calendar/calextras/eeae.html

31 October–2 November, Changes in Climate and Environment at High-Latitudes, Tromsø, Norway
Contact Kai-Rune Mortensen (conference secretary)
E–mail: kairm@ibg.uit.no
http://www.ibg.uit.no/geologi/konferanser/clienvir/index.html

10-15 November , Abrupt Climate Change Dynamics, Il Ciocco, Italy
Contact: Keith Alverson, PAGES IPO, Barenplatz 2, 3011 Bern Switzerland. Tel: +41 31 312 31 33 Fax: +41 31 312 31 68
E–mail: alverson@pages.unibe.ch
http://www.esf.org/euresco/01/lc01170a.htm

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  V. Markgraf et al., P.A. Colinvaux et al.; Z. An; F. Gasse
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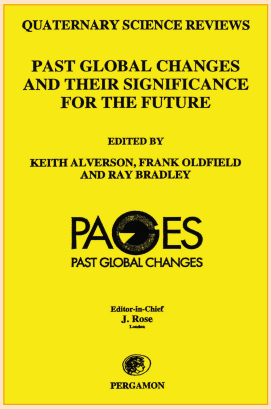

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